

producing a concrete, useful and tangible result (e.g., including supplying or making available the determined displacement for further analysis or processing). This determination can be useful in lithography among other contexts. Accordingly, Applicant respectfully requests withdrawal of the rejection of claim 1-7 and 21-24 under 35 U.S.C. §101.

REJECTION UNDER 35 U.S.C. §112, FIRST PARAGRAPH

Claims 18 and 19 stand rejected under 35 U.S.C. §112, first paragraph, as allegedly failing to comply with the written description requirement. [Office Action, pg. 3]. In particular, the Office Action alleges that the features of a relatively fixed additional measuring mirror having a line normal thereto which makes a non-zero acute angle with the z-axis, and that the additional measuring beam is incident on the additional measuring mirror in a direction substantially parallel to the line normal to the additional measuring mirror as recited in claim 18 were not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor, at the time the application was filed, had possession of the claimed invention with respect to its dependence on claim 17.

In response, claim 18 has been amended to depend from claim 16. Accordingly, Applicant respectfully requests withdrawal of the rejection of claims 18 and 19 under 35 U.S.C. §112, first paragraph.

ALLOWED CLAIM

In the Office Action, at pg. 24, the Office Action states that claim 20 is allowed and provides reasons for allowance. Applicant respectfully traverses the expressed reasons for allowance. Specifically, it is submitted that the subject matter of the allowed claims is patentable for their respective recitations of claimed combinations as a whole, without any particular criticality or distinguishing feature being attributable to any one or more of such features, and without any narrowing interpretation being imposed on any of such features.

REJECTIONS UNDER 35 U.S.C. §102

Claims 1-2 and 6 stand rejected under 35 U.S.C. §102(b) as allegedly being anticipated by the disclosure CIRP-1999 to Peggs *et al.* ("Peggs"). [Office Action, pg. 6]. Claim 7 stands rejected under 35 U.S.C. §102(b) as allegedly being anticipated by U.S. Patent No. 6,285,457 to Ukaji ("Ukaji"). [Office Action, pg. 9]. Applicant respectfully traverses

these rejections for at least the reason that Peggs and Ukaji neither explicitly nor impliedly discloses each of the elements of claims 1-2 and 6-7.

A patent claim is anticipated if a prior art reference discloses, either expressly or inherently, all of the limitations of the claim. Applicant respectfully disagrees with the propriety of the rejection. However, solely in an effort to expedite prosecution, claims 1-2 have been amended to clarify points of novelty over Peggs. As such, claim 1 is directed to a method of determining the displacement of an object in an apparatus along a z-direction and recites, *inter alia*, providing a measuring laser beam that is directed substantially perpendicularly incident on a measuring mirror with a fixed position relative to the object such that a reference line normal to the measuring mirror makes a non-zero acute angle with said z-direction, the measuring laser beam being substantially retro-reflected and at least partly overlapping said reference beam to provide an interference signal, the object to be illuminated by a beam of radiation having an optical axis extending along the z-direction in claim 1.

With this said, Applicant points out that the cited portions of Peggs clearly fail to disclose each and every element of claim 1. In particular, the cited portions of Peggs describe a small volume coordinate measuring machine (SCMM) configured to measure six degrees of freedom of a probe carrier using three compact displacement/angle laser interferometer and three miniature dual-axis autocollimators. The interferometers measure the displacement of a 'reflector cube' assembly, which includes three mutually orthogonal plates onto which three mirrors are mounted. The three mirrors are mounted at an angle to the z-axis of the CMM, such that light from the interferometers are incident on and reflected from the surface of the mirrors in a orthogonal direction. A CMM probe is mounted with the 'reflector cube' assembly to the CMM z-axis, such that the CMM probe contacts the surface of the artifact being measured. The measurements from the laser interferometer are used to calculate the position of the CMM probe with respect to a metrology frame, upon which the artifact being measured is placed. See, Figure 1 and section 2.1 of Peggs.

The invention as recited in claim 1 differs from the disclosure of Peggs in at least including a object being illuminated by a beam of radiation having an optical axis extending along the z-direction. In the Office Action, this feature was not given patentable weight. In particular, the Office Action alleges that features within a preamble of a claim are denied the effect of a limitation where the claim is drawn to a structure and the portion of the claim

following the preamble is a self-contained description of the structure not depending for completeness upon the introductory clause. [Office Action, page 7].

Applicant respectfully traverses this rejection and strongly disagrees with the assertion this feature recited in the preamble of claim 1 does not further define the claim. However, merely in order to expedite prosecution and without acceding to the merits or substance of the rejection, claim 1 has been amended to positively recite this feature within the body of the claim. Thus, these features must be given patentable weight.

As discussed above, the cited portions of Peggs do not disclose at least this feature. The SCMM of Peggs allows precise measurements of artifacts using a laser interferometer; however, there is nothing within Peggs to disclose illuminating an object being measured by a beam of radiation having an optical axis extending along the z-direction.

Claim 2 is directed to a method of determining the displacement of an object in an apparatus along the z-direction, and recites, *inter alia*, providing an interferometer system including at least one mirror, wherein the at least one mirror includes a measuring mirror with a fixed position relative to the object and having a mirror surface in which a reference line normal to the mirror surface makes a non-zero acute angle with the z-direction, the object having a surface that extends substantially in a plane perpendicular to the z-direction, the surface of the object to be illuminated by a beam of radiation having an optical axis extending along the z-direction in claim 2.

The invention as recited in claim 2 differs from the disclosure of Peggs in at least including an object having a surface which extends substantially in a plane perpendicular to the z-direction and which is illuminated by a beam of radiation having an optical axis extending along the z-direction. Again, the Office Action does not give this feature patentable weight.

Applicant respectfully traverses this rejection and strongly disagrees with the assertion this feature recited in the preamble of claim 1 does not further define the claim. However, merely in order to expedite prosecution and without acceding to the merits or substance of the rejection, claim 1 has been amended to positively recite this feature within the body of the claim. Thus, these features must be given patentable weight.

As discussed above, the cited portions of Peggs do not disclose at least this feature. The SCMM of Peggs allows precise measurements of artifacts using a laser interferometer; however, there is nothing within Peggs to disclose illuminating an object being measured by a beam of radiation having an optical axis extending along the z-direction.

Therefore, the cited portions of Peggs fail to anticipate claims 1-2 at least because they fail to disclose all the features of claims 1-2. Claim 6 is patentable over Peggs at least by virtue of its dependency from claim 2, and for the additional features recited therein.

With regard to claim 7, Applicant respectfully disagrees with the propriety of this rejection. However, solely in an effort to expedite prosecution, claim 7 has been amended to recite features similar to those recited in allowed claim 20 and to clarify points of novelty over Ukaji. As such, claim 7 is directed to a method of determining the displacement of an object in an apparatus along the z-direction, the object having a surface which extends substantially in a plane perpendicular to the z-direction and which is illuminated by a beam of radiation having an optical axis extending along the z-direction and recites, *inter alia*, providing an interferometer system including providing the reference laser beam and the measuring laser beam, wherein the measuring laser beam has a direction of incidence on the measuring mirror outside a plane in which the z-direction and said normal to said mirror surface lie and is directed towards the measuring mirror such that the measuring laser beam is reflected by the measuring mirror towards the separate mirror in a direction substantially perpendicular to the separate mirror and at least partly overlaps the reference laser beams to provide an interference signal, wherein the normal to the measuring mirror surface is substantially parallel to a direction of incidence of the measuring laser beam on the measuring mirror surface in claim 7.

With this said, Applicant points out that the cited portions of Ukaji clearly fail to disclose each and every element of claim 7. In particular, the cited portions of Ukaji describe an exposure apparatus, by which measurement of a position or displacement of a stage can be performed including a projection optical system 3, a barrel supporting member 4 for supporting the projection optical system, a base 13 for supporting a stage, a base measuring means for measuring at least one position and a displacement of the base with respect to the barrel supporting member and a stage measuring means for measuring at least one of a position and a displacement of the stage with respect to the barrel supporting member. *See*, column 2, lines 55-65 of Ukaji. The apparatus includes a wafer chuck 20 for carrying a wafer and a top stage 21 for carrying the wafer chuck 20. *See*, column 5, lines 20-25 of Ukaji. Connected to top stage 21 are mirrors having reflective surfaces 31a and 31b, where reflective surface 31b is at an angle to the plane of the top stage 21. Radiation Ld from interferometer

33d is incident obliquely onto mirror 31b which is then reflected to stationary mirror 35. *See*, column 5, line 63 – column 6, line 10 of Ukaji.

The invention as recited in claim 7 differs from the disclosure of Ukaji in at least including a measuring laser beam that has a direction of incidence on the measuring mirror outside a plane in which the z-direction and said normal to said mirror surface lie and is directed towards the measuring mirror such that the measuring laser beam is reflected by the measuring mirror towards the separate mirror in a direction substantially perpendicular to the separate mirror. As discussed above, Ukaji discloses projecting light at an oblique angle from interferometer 33d onto angled mirror 31b, which is then incident on stationary mirror 35, but does not disclose projecting the light on the measuring mirror outside a plane in which the z-direction and said normal to said mirror surface lie as is claimed.

Therefore, the cited portions of Ukaji fail to anticipate claim 7 at least because they fail to disclose all the features of claim 7.

Thus, Applicant respectfully requests that the rejection of claims 1-2 and 6-7 under 35 U.S.C. §102(b) be withdrawn and the claims be allowed.

REJECTIONS UNDER 35 U.S.C. §103

Claims 1-6, 8-15, 21 and 23 stand rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Ukaji in view of Peggs. [Office Action, pg. 11]. Claims 16 and 17 stand rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Ukaji in view of Peggs and in further view of U.S. Patent No. 5,801,832 to Van Den Brink (“Van Den Brink”). [Office Action, pg. 22]. Claims 22 and 24 stand rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Ukaji in view of Peggs and in further view of U.S. Patent No. 6,122,036 to Yamasaki *et al.* (“Yamasaki”). [Office Action, pg. 23]. Applicant respectfully traverses these rejections for *at least* the reason that a *prima facie* case of obviousness has not been established.

With regard to claim 1, the Office Action acknowledges that Ukaji fails to disclose the claimed feature of providing a measuring laser beam that is directed substantially perpendicularly incident on a measuring mirror with a fixed position relative to the object such that a reference line normal to the measuring mirror makes a non-zero acute angle with the z-direction [Office Action, page 20]. The Office Action then states that this feature is taught by Peggs and that it would have been obvious to one having ordinary skill in the art at

the time of invention to modify Ukaji by replacing the z-axis measurement interferometer 33d and mirror 35 of Ukaji with an interferometer in which the measurement beam is incident perpendicularly on the mirror 35 because it would reduce parts in the system. [Office Action, page 20].

Reconstructing the exposure apparatus of Ukaji in an effort to create the invention as recited in claim 1 by incorporating the interferometer of Peggs would modify the operational aspects of Ukaji to such a degree that the exposure apparatus would not function as described.

In particular, as discussed above, the exposure apparatus of Ukaji includes a wafer chuck 20 for carrying a wafer and a top stage 21 for carrying the wafer chuck 20. Connected to top stage 21 are mirrors having reflective surfaces 31a and 31b, where reflective surface 31b is at an angle to the plane of the top stage 21. Radiation Ld from interferometer 33d is incident obliquely onto mirror 31b which is then reflected to stationary mirror 35. In order for Ukaji to be modified as suggested in the Office Action, the position of interferometer 33d would need to be moved or additional optics employed to direct the radiation from interferometer 33d at an angle normal to the surface of mirror 31b. Furthermore, the proposed modification will render the calculation circuit of the control unit 30 inoperable since, as shown in FIGS. 2 and 3, Ukaji makes use of the parallelism of laser beams La, Lb and Ld along the x axis to calculate displacement d1, d2 and Δz . Thus, making Ukaji unsatisfactory for its intended purpose. Therefore, there is not a proper basis for an obviousness rejection.

Furthermore, the Examiner has not provided the requisite analysis as to why one of ordinary skill in the art would combine the elements of Ukaji and Peggs in the manner that the Examiner has proposed. See *KSR Int'l. Co. v. Teleflex, Inc.*, No. 04-1350, slip opinion at page 14 (U.S. Apr. 30, 2007) (a determination must be made as to "whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue. To facilitate review, this analysis should be made explicit"). Instead, the Examiner has only offered a conclusory statement that the number of parts in the system of Ukaji would be reduced. This is clearly inadequate under the Supreme Court's *KSR* decision since the Office Action cites absolutely nothing which supports such a conclusion. Quite to the contrary, it is respectfully submitted that the proposed modification will necessitate a plurality of additional optics (e.g., additional optics to redirect the beam reflected by the surface 31b toward the control unit 30) and a complete reconfiguration of the calculation unit. As such one of

ordinary skill in the art would not be motivated to modify Ukaju in the manner proposed by the Examiner. In addition, a mere statement that a purported modification allows a particular capability (i.e., reduction in parts involved) is not a sufficient basis for an obviousness determination. Absent a teaching within the references themselves, or in the knowledge generally available to one of ordinary skill in the art, suggesting a desirability of directing a measurement beam in substantially a perpendicular direction onto the surface of the mirror within the particular context of Ukaji's arrangement and in the particular manner posited by the Office Action, the purported modification is legally incapable of supporting an obviousness determination. Thus, the purported motivation cited in the Office Action fails to provide a basis for modifying Ukaji and also fails to render obvious the particular modification (i.e., providing a measuring laser beam that is directed substantially perpendicularly incident on a measuring mirror with a fixed position relative to the object such that a reference line normal to the measuring mirror makes a non-zero acute angle with the z-direction) upon which the rejection is based.

For *at least* this reason, there is no legally proper teaching, suggestion, or motivation to modify Ukaji with the teaching of Peggs in the manner posited by the Office Action. Accordingly, the rejection is improper and should be reversed.

Claim 2 recites similar aspects as claim 1 and is allowable for similar reasons as discussed above with respect to claim 1, and for the additional features recited therein. Ukaji and Peggs, either alone or in combination, fails to teach or suggest a method of determining the displacement of an object in an apparatus along a z-direction, the object having a surface which extends substantially in a plane perpendicular to the z-direction and which is illuminated by a beam of radiation having an optical axis extending along a z-direction as recited in claim 2. For example, the recited features including providing an interferometer system including at least one mirror, wherein the at least one mirror includes a measuring mirror with a fixed position relative to the object and having a mirror surface in which a reference line normal to the mirror surface makes a non-zero acute angle with said z-direction, wherein the object having a surface which extends substantially in a plane perpendicular to said z-direction and which is illuminated by a beam of radiation having an optical axis extending along the z-direction are not taught or suggested from the disclosure of Ukaji and Peggs, either alone or in combination.

Claims 3-6 are patentable over Ukaji and Peggs, either alone or in combination, at least by virtue of their dependency from claim 2, and for the additional features recited therein.

Claim 8 recites similar aspects as claim 1 and is allowable for similar reasons as discussed above with respect to claim 1, and for the additional features recited therein. Ukaji and Peggs, either alone or in combination, fails to teach or suggest a lithographic apparatus as recited in claim 8. For example, the recited features including an interferometer system configured to determine a displacement of the object along a z-direction, the interferometer system including at least one mirror, wherein the at least one mirror includes a measuring mirror with a fixed position relative to the object and having a mirror surface in which a reference line normal to the mirror surface makes a non-zero acute angle with the z-direction, wherein the normal to the mirror surface is substantially parallel to a direction of incidence on the measuring laser beam on the mirror surface are not taught or suggested from the disclosure of Ukaji and Peggs, either alone or in combination.

Claims 9-15 are patentable over Ukaji and Peggs, either alone or in combination, at least by virtue of their dependency from claim 8, and for the additional features recited therein.

Claim 21 recites similar aspects as claim 1 and is allowable for similar reasons as discussed above with respect to claim 1, and for the additional features recited therein. Ukaji and Peggs, either alone or in combination, fails to teach or suggest a device manufacturing method as recited in claim 21. For example, the recited features including determining a displacement of the object along the z-direction by providing a measuring laser beam that is directed substantially perpendicularly incident on a measuring mirror with a fixed position relative to the object such that a reference line normal to the measuring mirror makes a non-zero acute angle with the z-direction are not taught or suggested from the disclosure of Ukaji and Peggs, either alone or in combination.

Claim 23 recites similar aspects as claim 1 and is allowable for similar reasons as discussed above with respect to claim 1, and for the additional features recited therein. Ukaji and Peggs, either alone or in combination, fails to teach or suggest a device manufacturing method as recited in claim 23. For example, the recited features including providing an interferometer system configured to determine a displacement of the object along a z-direction, the interferometer system including at least one mirror, wherein the at least one

mirror includes a measuring mirror with a fixed position relative to the object and having a mirror surface in which a reference line normal to the mirror surface makes a non-zero acute angle with the z-direction, wherein the normal to the mirror surface is substantially parallel to a direction of incidence of the measuring laser beam on the mirror surface are not taught or suggested from the disclosure of Ukaji and Peggs, either alone or in combination.

With specific regard to claims 16-17, 22 and 24, the obviousness-based rejections fail to address the features incorporated into claims 16-17, 22 and 24 by virtue of their dependency from claims 8, 21 and 23, respectively. The obviousness-based rejections therefore should be withdrawn because they fail to address the complete combination of features represented by claims 16-17, 22 and 24.

To the extent the obviousness-based rejections are premised on the anticipation-based rejections of claims 8, 21 and 23, it is respectfully submitted that the obviousness-based rejections should be withdrawn for at least the same aforementioned reasons that require withdrawal of the anticipation-based rejections.

Claims 16 and 17 depend from claim 8, and therefore are construed to include the features of claim 8. Since Ukaji and Peggs, either alone or in combination, do not teach or suggest all of the features of claim 8 and the cited portions of Van Den Brink fail to cure the aforementioned deficiencies of Ukaji and Peggs, dependent claims 16 and 17 are allowable by virtue of their dependence from an allowable base claim, and for the additional features they recite.

Claim 22 depends from claim 21, and therefore is construed to include the features of claim 21. Since Ukaji and Peggs, either alone or in combination, do not disclose all of the features of claim 22 and the cited portions of Yamasaki fail to cure the aforementioned deficiencies of Ukaji and Peggs, dependent claim 22 is allowable by virtue of its dependence from an allowable base claim, and for the additional features it recites.

Claim 24 depends from claim 23, and therefore is construed to include the features of claim 23. Since Ukaji and Peggs, either alone or in combination, do not disclose all of the features of claim 24 and the cited portions of Yamasaki fail to cure the aforementioned deficiencies of Ukaji and Peggs, dependent claim 24 is allowable by virtue of its dependence from an allowable base claim, and for the additional features it recites.

In addition, it is respectfully submitted that there are significant structural and functional differences between the teachings of Ukaji and Peggs, on the one hand, and the

teachings of Van Den Brink and Yamasaki, on the other hand. Those differences are such that it would not have been obvious to combine the teachings of Ukaji and Peggs with the divergent teachings of Van Den Brink or Yamasaki, let alone to have selectively extracted from those references the particular features cited in the Office Action and to have combined them in the manner posited by the Office Action. The cited art provides no motivation for the combination. A purported desire to provide the arrangement of Ukaji with a single laser source for interferometers 33a-33d, 34a and 34b as taught in Van Den Brink or an additional alignment mark as taught in Yamasaki, would not have motivated one skilled in the art to adopt the features selectively extracted from the secondary references by the Office Action. Such a combination would have required improper hindsight gleaned from Applicant's disclosure.

Thus, Applicant respectfully requests that the rejection of claims 1-6, 8-17 and 21-24 under 35 U.S.C. §103(a) be withdrawn and the claims be allowed.

CONCLUSION

Having addressed each of the foregoing rejections, it is respectfully submitted that a full and complete response has been made to the outstanding Office Action and, as such, the application is in condition for allowance. Notice to that effect is respectfully requested.

If the Examiner believes, for any reason, that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at the number provided.

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Respectfully submitted,

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Enclosure: Informal Replacement Drawing Sheets (FIG. 3)